

VALLEY PEATLAND FLORA OF IDAHO

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ABSTRACT

Twenty-eight low elevation peatlands in Idaho and northeastern Washington were surveyed for their flora. The flora contains 20 bryophyte and 291 vascular species, 62% of the species are boreal, 22% are western cordilleran, and 16% are widespread. Although most species are of boreal affinity, the Idaho peatland flora has relatively low similarity to other peatland floras in North America. The low similarity may be explained in part by the lack of trees and ericaceous shrubs in Idaho peatlands, and the relatively unknown status of Idaho's bryophyte flora. Five species, previously unknown for Idaho, were documented as peatland inhabitants: *Carex chardorrhiza*, *Eleocharis tenuis*, *Eriophorum viridicarinatum*, *Iris versicolor*, and *Rubus pubescens*.

Floristic and phytogeographic studies of peatlands have been conducted in many parts of boreal and northern temperate North America (Glaser and Foster 1984 in Labrador; Jeglum 1971 in Saskatchewan; Moss 1953 in Alberta; Janssens 1967 and Wheeler et al. 1983 in Minnesota; Lesica 1986 in Montana). Floristic and phytogeographic trends and interrelationships among northern temperate and boreal peatlands have also been documented from numerous studies of peatland vegetations (Slack et al. 1980 and Vitt et al. 1975 in Alberta; Damman and Dowhan 1981 in Nova Scotia; Pollett and Bridgewater 1973 and Wells 1981 in Newfoundland; Jeglum 1975 and Vitt and Bayley 1984 in Ontario; Ovenden and Brassard 1989 in the Yukon; Schwintzer and Williams 1974, Vitt and Slack 1975, and Schwintzer 1978a, b in Michigan; Glaser 1983, in Minnesota; Damman and French 1987, Dunlop 1987, Karlin and Lynn 1988, Motzkin and Patterson 1991, and Mitchell and Niering 1993 in the northeastern U.S.; Stewart and Nilsen 1993 in Appalachia). Peatlands of Idaho, however, escaped intensive floristic and phytogeographic study until the study of Bursik (1990). Only one vegetational study (Rumley 1956) from this region (Hager Lake in Bonner Co., Idaho) had been accomplished prior to 1990. The vegetation and flora of Hager Lake were reanalyzed in 1992 to document changes during the last four decades.

Bursik (1990) recognized two broad types of peatlands in the northwestern Rocky Mountains based on vascular floristics: subalpine peatlands that generally form along low gradient streams and

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around lakes at mid- to high elevations, and low elevation lacustrine peatlands which typically form around lakes in large river valleys in parts of this region. This study focuses on the latter. We refer to these low elevation peatlands as valley peatlands, in recognition of their position on the landscape, regardless of the presence of a lacustrine open body of water, which is present in most, but not all of the study sites. Valley peatlands are dominated by boreal species which range through all or part of the northern boreal regions. Sub-alpine peatlands are characterized by numerous cordilleran species which are generally restricted to the ranges of mountains in western North America. Valley peatlands support relatively few cordilleran species.

The current study includes bryophytes as well as vascular plants, whereas the previous study by Bursik (1990) included only vascular species. Ordination studies undertaken throughout Canada indicate that bryophyte species respond to water chemistry changes and are, therefore, most valuable in elucidating local conditions which may shape species composition and abundance (Horton et al. 1993).

STUDY AREA DESCRIPTION

The study sites include 26 in Idaho and two in Pend Oreille County, Washington (Table 1). Both Washington sites are in the Priest River Valley, which drains half of the extreme northern Panhandle of Idaho, and supports the majority of valley peatlands in Idaho. The 28 sites represent a general north-south transect ($48^{\circ}, 46'$ in Boundary County, to $44^{\circ}, 02'$ in Fremont County) through the peatland-supporting portion of Idaho (Fig. 1). The sites range in elevation from 641 meters at Gamble Lake to 2000 meters at Robinson Lake (Table 1). Elevation increases along the transect from north to south. Legal locations of the study sites are also shown in Table 1.

Because of the latitudinal, elevational, and physiographic diversity of the region, it is difficult to characterize the climate of the valley peatland regions of Idaho. The climate of the Priest River Valley of northern Idaho, which supports the greatest concentration of valley peatlands in the state, has been described as "inland maritime" due to the prevailing westerlies, which carry air masses from the northern Pacific Ocean across the northern Rocky Mountains. Mean annual precipitation for the Priest River Experimental Forest in the southern part of the Priest River Valley is 81.3 cm, most of which occurs during the winter in the form of snow. The mean annual temperature is 6.8°C with a mean temperature of 18.2°C in July and -4.6°C in January (Cooper et al. 1987). The rest of the peatland regions of Idaho are similar, but somewhat drier and cooler in the higher elevations of the southern part of the study area.

TABLE 1. LOCATION, ELEVATION, AND LATITUDE OF 28 VALLEY PEATLAND STUDY SITES IN IDAHO AND WASHINGTON, U.S.A. Sites are listed in numerical sequence from north to south. S = Section, T = Section, R = Range. Legal locations without sections are unsurveyed.

Site & Number	County	Legal location	Elevation (m)	Latitude
Upper Priest Lake (1)	Bonner	S33 T63N R4W	790	48°46'
Mosquito Bay (2)	Bonner	S10 T62N R3W	752	48°45'
Armstrong Meadows (3)	Bonner	S5 T62N R4W	794	48°45'
Bottle Lake (4)	Bonner	S20 T62N R4W	872	48°45'
Perkins Lake (5)	Boundary	S5 T62N R3E	810	48°45'
Huff Lake (6)	Pend Orielle	S15 T36N R45W	820	48°44'
Packer Meadows (7)	Bonner	S21 T62N R5W	1120	48°42'
Rose Fen (8)	Boundary	S3 T61N R3E	751	48°40'
Three Ponds (9)	Boundary	S14 T61N R1W	1124	48°37'
Potholes (10)	Bonner	S20 T61N R5W	900	48°36'
Deerhorn Cr. Meadows (11)	Pend Orielle	S15 T36N R45W	920	48°36'
Hager Lake (12)	Bonner	S34 T61N R5W	800	48°36'
MacArthur Lake (13)	Boundary	S27 T60N R1W	642	48°30'
Lee Lake (14)	Bonner	S11 T59N R4W	762	48°20'
Chase Lake (15)	Bonner	S14 T59N R4W	768	48°27'
Kaniksu Marsh (16)	Bonner	S25 T59N R4W	738	48°26'
Chippunk Potholes (17)	Bonner	S31 T59N R4W	740	48°25'
Gamble Lake (18)	Bonner	S7 T56N R1E	641	48°13'
Shepherd Lake (19)	Bonner	S23 T56N R2W	702	48°11'
Rose Lake (20)	Kootenai	S33 T49N R1W	653	47°33'
Lily Lake (21)	Valley	S27 T19N R3E	1527	44°57'
Tule Lake (22)	Valley	S13 T15N R6E	1630	44°37'
Big Springs (23)	Fremont	S33 T13N R44E	1963	44°30'
Genital Meadows (24)	Fremont	T10N R46E	1994	44°10'
Robinson Lake (25)	Fremont	T10N R46E	2000	44°10'
West Boundary Trail Meadows (26)	Fremont	T10N R45E	1994	44°08'
Rock Creek Potholes (27)	Fremont	S10 T9N R45E	1965	44°08'
Indian Lake (28)	Fremont	S32 T9N R46E	1963	44°04'

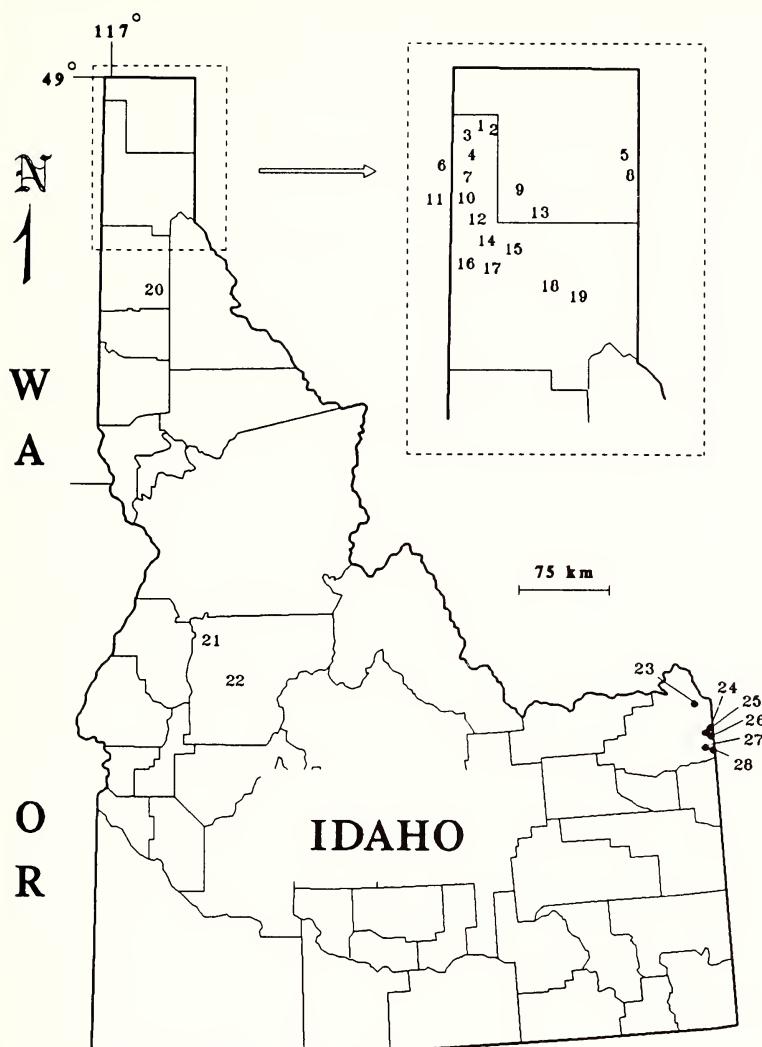


FIG. 1. Location of 28 peatland study sites in Idaho and adjacent northeastern Washington. Study sites and numbers are listed in Table 1.

The uplands adjacent to valley peatlands in northern Idaho and northeastern Washington are dominated by western temperate coniferous forests characterized by *Larix occidentalis*, *Pseudotsuga menziesii*, *Pinus contorta*, *P. ponderosa*, *P. monticola*, *Abies grandis*, *Tsuga heterophylla*, and *Thuja plicata*. *Pinus contorta*, *P. ponderosa*, and *Pseudotsuga menziesii* are dominant in the southern part of the study region. Valley peatlands occur in cirques, glacial kettles, glacial

scours, and glacial outwash channels, and are the product of continental Pinedale Wisconsin glacial activity (Rabe et al. 1986).

The 28 study sites represent predominantly *Sphagnum*-rich peatlands with oligotrophic ground waters (Horton et al. 1993). Several sites, e.g., Rose Fen, are *Sphagnum*-poor peatlands, dominated by brown mosses, sedges, and other graminoids. In the traditional sense, the *Sphagnum*-rich peatlands are fens, ranging from poor fens to moderately rich (mesotrophic) fens. Several of the poor fen sites (e.g., Chase Lake and Huff Lake) include localized raised bog (ombrotrophic) habitats dominated by *Sphagnum fuscum*, although the rich floras of each of these areas, considered as a whole, indicate the presence of predominantly poor fen conditions.

METHODS

Twenty-eight sites, selected to represent a diversity of valley peatlands in Idaho, and adjacent Washington were studied from 1987 to 1993. Most of the peatlands are located on federal lands and several are included within Research Natural Areas (Table 1).

Most study sites were visited at different times during the growing season to document phenological changes in the vascular flora. Terrestrial (mat) habitats were surveyed extensively on foot. Open water was covered by canoe, inflatable raft, or by wading. To account for as much floristic diversity as possible, particular attention was given to habitats characterized by different types of vegetation, various degrees of microtopographic relief, and varied patterns of drainage.

The establishment of peatland boundaries for sampling was based on the presence of moist to wet peat soils dominated by peat mosses, brown mosses (e.g., *Aulacomnium palustre* and *Calliergon stramineum*), sedges and other characteristic wetland taxa. The narrow transition from peat to predominantly mineral soils supporting upland trees was considered the peatland boundary. Extensive paludified forest exists in several of the sites (e.g., Mosquito Bay, Armstrong Meadows, Lee Lake). Upland tree species such as *Tsuga heterophylla* and *Pinus contorta* were included in the species lists if they occurred on peat or on thick mats of *Sphagnum centrale*. Although no tree species are specifically adapted to peatland habitats in the region, most of the locally dominant conifers occur in the paludified habitats and scattered on raised hummocks in other, non-paludified portions of the peatlands.

Over 2000 voucher specimens were collected to document this study and are deposited in the University of Idaho Herbarium (ID). Data from these collections and specimens already on deposit in ID were used in compiling floristic lists for each study area. Nomenclature follows Hitchcock and Cronquist (1973) and Moss (1959) for Angiosperms, Flora of North America Editorial Committee (1993)

for Pteridophytes and Gymnosperms, Lawton (1971) for non-*Sphagnum* bryophyte species, and Andrus and Layser (1976) for *Sphagnum* spp.

Sorenson's Index of Similarity, with the formula: $S = (2w/a + b) \times 100$, where w is the number of species in common between two areas, and a and b are the number of species in areas A and B, respectively, was used to compare the valley peatland flora of Idaho with other regional peatland floras in North America. Sorenson's Index has been used in other phytogeographic studies (e. g., Wheeler et al. 1983; Lesica 1986). All comparisons were done at the species level. Species lists from other geographic regions in North America were compiled from the following studies: Lesica (1986) for north-central Montana; Jeglum (1975) and Vitt and Bayley (1984) for Northern Ontario; Vitt and Slack (1975), and Schwintzer (1978b) for northern Michigan; Damman and French (1987) for the Northeastern U.S.; Glaser (1983) for northern Minnesota; Wheeler et al. (1983) for the Red Lake Peatland in Minnesota; Jeglum (1971) for Saskatchewan; and Moss (1953), Slack et al. (1980), and Vitt et al. (1975) for Alberta.

RESULTS

The valley peatland flora of the northwestern Rocky Mountains consists of 311 species, 20 bryophytes and 291 vascular (Table 2). The Cyperaceae is the most prominent vascular family with six genera and 46 species, accounting for 15% of the flora. *Carex* with 32 species and *Sphagnum* with 11 species are the most important genera in the flora.

One hundred ninety-three of the 311 species (62%) are boreal in distribution, most of which are at or near their southern limit in Idaho. Sixty-nine species (22%) have ranges centered in the western cordillera of North America, and 49 species (16%) are widespread in North America or cosmopolitan in distribution (Table 2). The last group also includes introduced weeds of wide or local distribution in North America.

Thirty species (10%) in the valley peatland flora are considered rare in Idaho (Moseley and Groves 1992). Five of these species were undocumented in Idaho prior to this study: *Carex chordorrhiza*, *Eleocharis tenuis*, *Eriophorum viridicarinatum*, *Iris versicolor*, and *Rubus pubescens*.

Forty-four of the 69 cordilleran species (64%) occur in three or fewer sites. Most of these species occur on moist, minerotrophic margins in areas otherwise characterized by poor fen conditions. Other cordilleran species are characteristic of dried or disturbed habitats within the peatlands. Very few of the cordilleran species occur on fixed or floating mat locations on deep peat. Exceptions

TABLE 2. CHECKLIST OF VASCULAR PLANT SPECIES IN PEATLANDS OF IDAHO. P = phytogeographic affinity (b = boreal; w = western cordilleran; c = cosmopolitan or widespread North American); x = present, o = absent; 1 = Upper Priest Lake Fen; 2 = Perkin's Lake; 3 = Mosquito Bay; 4 = Bottle Lake; 5 = Armstrong Meadows; 6 = Huff Lake; 7 = Packer Meadows; 8 = Rose Fen; 9 = Three Ponds; 10 = Potholes; 11 = Deerhorn Creek Meadows; 12 = Hager Lake; 13 = MacArthur Lake; 14 = Lee Lake; 15 = Chase Lake; 16 = Kaniksu Lake; 17 = Chipmunk Potholes; 18 = Gambel Lake; 19 = Sheephead Lake; 20 = Rose Lake; 21 = Lily Lake; 22 = Fork Fen; 23 = Henry's Fork Fen; 24 = Gentian Meadow; 25 = Robinson lake; 26 = West Boundary Creek Meadow; 27 = Rock Creek Potholes; 28 = Indian Lake. Nomenclature follows Hitchcock and Cronquist (1973) or Moss (1959) for Angiosperms; Flora of North America Editorial Committee (1993) for Pteridophytes and Gymnosperms; Andrus and Layser (1976) (for *Sphagnum*); and Lawton (1971) (for other bryophytes).

TABLE 2. CONTINUED

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	P	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Asteraceae																													
<i>Anaphalis margaritacea</i> (L.) Britt.	b	o	x	o	o	o	o	o	x	o	o	x	o	x	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Antennaria microphylla</i> Rydb.	w	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o
<i>Arnica amplexicaulis</i> Nutt. <i>Arnica latifolia</i> Bong.	w	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Aster eatonii</i> (Gray) Howell	w	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Aster foliaceus</i> Lindl.	w	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	x	o	o	x	o	o	o
<i>Aster junciformis</i> Rydb.	b	o	x	o	o	o	o	x	o	o	x	o	o	x	x	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Aster modestus</i> Lindl.	w	x	o	o	o	x	o	o	o	o	o	o	o	x	o	o	x	o	x	x	o	o	o	o	o	o	o	o	o
<i>Bidens cernua</i> L.	b	o	o	o	x	o	o	o	o	o	o	o	o	x	x	o	o	x	x	o	o	o	x	o	o	x	x	o	o
<i>Bidens vulgata</i> Greene	c	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o
<i>Cirsium arvense</i> (L.) Scop.	b	o	x	o	o	o	o	o	o	x	o	x	o	x	o	o	x	o	o	o	o	o	o	o	o	o	o	o	
<i>Cirsium vulgare</i> (Savi) Tenore	c	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	x	o	o	o	o	o	o	o	o	o
<i>Erigeron peregrinus</i> (Pursh) Greene	w	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o
<i>Helianthella uniflora</i> (Nutt.) T. & G.	w	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o
<i>Hieracium albiflorum</i> Hook.	w	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Petasites sagittatus</i> (Banks) Gray	b	o	x	x	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o
<i>Senecio hydrophilus</i> Nutt. <i>Senecio indecorus</i> Greene <i>Senecio triangularis</i> Hook.	w	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Solidago canadensis</i> L.	w	x	x	o	o	o	o	o	o	o	o	o	o	x	x	o	o	o	o	o	o	o	o	o	o	o	o	o	o
<i>Tanacetum vulgare</i> L.	c	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o
<i>Taraxacum officinale</i> Weber	c	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o	o	o	o	o	x	o	o	o	o	o

TABLE 2. CONTINUED

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TABLE 3. SORENSEN'S INDEX OF SIMILARITY VALUES (S) FOR THE VALLEY PEATLAND FLORA OF IDAHO (WITH 311 SPECIES TOTAL) COMPARED WITH PEATLAND FLORAS FROM ELSEWHERE IN NORTH AMERICA. b = number of species on comparison flora; w = number of species in common.

Comparison flora and author(s)	b	w	S
Pine Butte Fen, Montana, U.S.A. (Lesica 1986)	102	54	26.2
Northwestern Alberta, Canada (Moss 1953; Slack et al. 1980)	247	98	35.1
Candle Lake, Saskatchewan, Canada (Jeglum 1971)	165	92	38.7
Red Lake Peatland, Minnesota, U.S.A. (Wheeler et al. 1983)	251	94	33.5
Northern Minnesota, U.S.A. (Glaser 1987)	297	94	30.9
Upper Great Lakes Region, U.S.A. (Crum 1988)	204	71	27.6
Northern Michigan, U.S.A. (Vitt and Slack 1975; Schwintzer 1978)	164	52	21.9
Northern Ontario, Canada (Jeglum 1975; Vitt and Bayley 1984)	84	36	18.2
Northeastern U.S.A. (Damman 1987)	155	28	12.0

include *Carex cusickii*, *Kalmia microphylla*, *Trientalis arctica*, and *Spiraea douglasii* (Table 2). The majority of the dominant species in the valley peatlands in Idaho are boreal, including *Sphagnum angustifolium*, *S. centrale*, *S. subsecundum*, *S. magellanicum*, *Carex lasiocarpa*, *C. utriculata*, *Dulichium arundinaceum*, *Drosera anglica*, *D. rotundifolia*, *Lycopus uniflorus*, *Menyanthes trifoliata*, *Potentilla palustris*, and *Scheuchzeria palustris*.

The valley peatland flora of Idaho was compared with peatland floras from elsewhere in North America using Sorenson's Index of Similarity (Table 3). Similarity values ranged from 12.0 for the Northeastern USA. to 38.7 for Candle Lake, Saskatchewan. Generally, the most distant comparison areas from Idaho were least similar (Northeastern USA; Northern Ontario; and Northern Michigan). Floristic similarity, however, did not necessarily increase with geographic proximity.

DISCUSSION

As is true with other northern temperate peatland floras, the valley peatland flora of Idaho contains few regional species adapted specifically to peatland habitats. Rather, the flora is comprised predominantly of boreal species at or near their southern range limits. This fact, however, makes the relatively low Similarity Index values between Idaho's valley peatland flora and other regional North American peatland floras somewhat surprising.

Water chemistries of valley peatlands in Idaho (Bursik 1990) fall within the range of water chemistry values given for *Sphagnum*-rich and *Sphagnum*-poor peatlands studied throughout North America (e.g., Vitt and Slack 1975; Schwintzer 1978a, b; Vitt and Bayley 1984). Although ombrotrophic habitats are localized and rare in valley peatlands of Idaho, poor, mesotrophic and rich fen conditions, as indicated by surface and subsurface water cation concentrations, alkalinity, pH, and conductivity values gathered at more than half of the study sites, are well-represented in the region (Bursik 1990). Additionally, fen habitats support far more species than do the ombrotrophic bog habitats (Wheeler et al. 1983), hence the lack of abundant bog habitat would exclude relatively few species from the region and could not alone account for the unique flora.

Lesica (1986) reported that floristic similarity with the flora of Pine Butte Fen decreased with increasing distance from Pine Butte Fen, and also decreased with decreasing pH of the peatland groundwater. The regional peatland floras nearest to Idaho are from Pine Butte Fen, Montana, and northwestern Alberta (Fig. 2). The two regions with peatland floras most similar to the peatland flora of Idaho, however, are the Candle Lake region of Saskatchewan, and Red Lake Peatland in northern Minnesota (Table 3). All of the studies except for Lesica (1986) represent a wide range of trophic diversity. The most distant comparison areas (northern Ontario, northern Michigan, and the Northeastern USA) were least similar to Idaho's valley peatland flora, otherwise no geographic trend is apparent. The surprisingly low floristic similarity with Pine Butte Fen, which is in the western cordillera, can perhaps be explained by the narrow range of chemical diversity of that area (minerotrophic fen), compared to the wide diversity of peatlands included in this study.

Several other factors may account for the overall lack of floristic similarity between the valley peatlands of Idaho and other regional peatlands examined. The most obvious source of uniqueness is the presence of 69 western cordilleran species which may be shared with only two of the comparison areas. Bryophyte diversity in Idaho is still poorly documented, which may account for the low similarity with other peatland floras. With the exception of the Pine Butte Fen flora, all other regional floras include thorough documentation of the bryophyte components. Most of those areas support more than 60 bryophyte species, whereas we documented only 20, all of which are boreal. Wheeler et al. (1983) noted an equal to greater similarity among bryophytes versus vascular species between Red Lake Peatland, Minnesota and other peatlands floras in North America and Europe. Further documentation of the bryophyte flora of valley peatlands in Idaho will likely produce more species in common with peatlands of other North American regions.

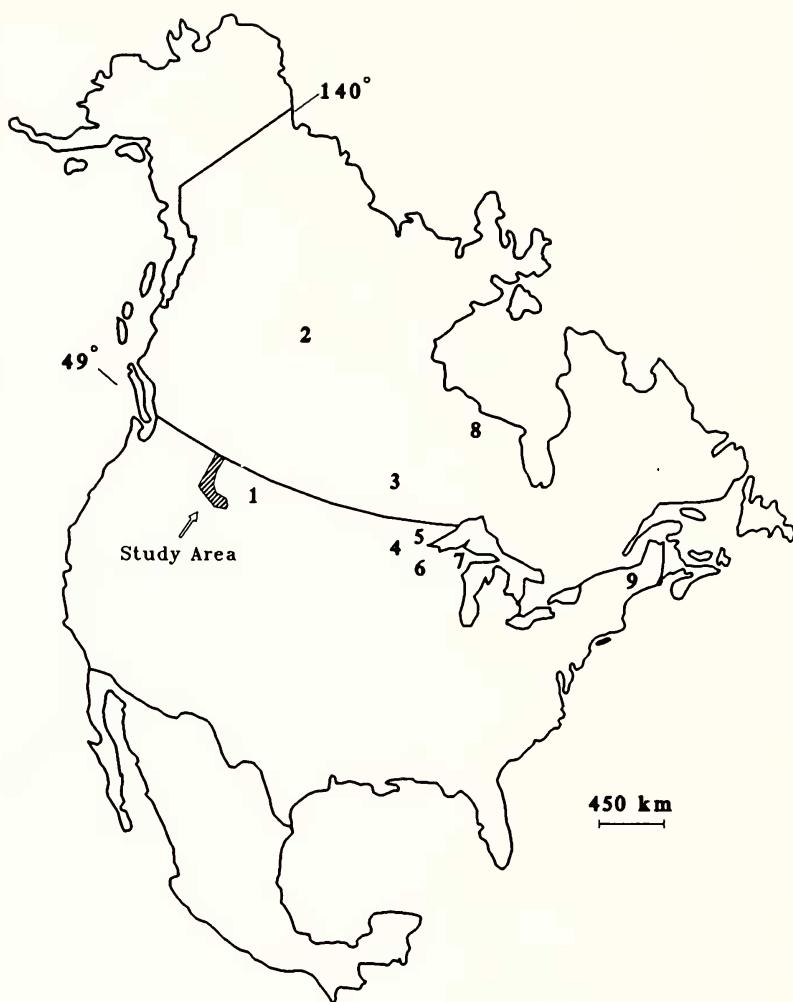


FIG. 2. North America with locations of study area in Idaho and regional peatland floras used for comparison. 1 = Pine Butte Fen, Montana; 2 = Northwestern Alberta; 3 = Candle Lake, Saskatchewan; 4 = Red Lake Peatland, Minnesota; 5 = Northern Minnesota; 6 = Upper Great Lakes Region; 7 = Northern Michigan; 8 = Northern Ontario; 9 = Northeastern USA. Publications from each of these sites are listed in Table 3.

We collected extensively in marginal minerotrophic to marshy areas and in aquatic habitats present within many of the study areas. These areas often support the greatest diversity of any habitat within a particular peatland due to mineral influences of adjacent uplands or inflowing streams. Most of the other regional studies from which

species lists were compiled were concerned only with true peatland habitats and did not include marginal habitats. Because many species in this flora are generally restricted to aquatic or marginal habitats, this also served to amplify differences between the Idaho valley peatland flora and other areas.

In boreal peatlands the three most important environmental factors influencing the development of peatland vegetation are trophic status of surface and groundwater, height of substrate surface above the water table, and degree of shading (Vitt and Bayley 1984; Vitt and Slack 1984; Kenel 1987). The first two factors also influence the abundance and distribution of species in Idaho's valley peatlands. Clearly, however, the absence of tree species adapted to peatlands must account for some of the uniqueness. Tree species adapted to peatland habitats account for the considerable physiognomic diversity of boreal peatland vegetation (Kenel 1987). Tree species such as *Picea glauca*, *P. mariana*, *Larix laricina*, *Thuja occidentalis*, and *Abies balsamea*, prominent components in boreal and other northern temperate peatlands, have no counterparts in valley peatlands in Idaho. Recently paludified forest habitats in Idaho are limited to the Priest River Valley, but the young age of these habitats, as evidenced by the shallow depth of the sphagnum mat and the persistence of tree species seemingly unsuited to such habitats, may not have allowed the development of a shade-tolerant portion of the flora that would accompany peatland tree species.

Unlike the peatlands of other North American regions, the valley peatlands of Idaho also lack a prominent ericaceous shrub component. *Ledum groenlandicum*, *Chamaedaphne calyculata*, *Gaylussacia baccata*, and *Vaccinium vitis-idaea*, which can form dense shrub covers in boreal peatlands, have no counterpart in Idaho. The suite of conditions created by such shrub stands are largely absent from Idaho peatlands as are the species suited to those conditions.

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LITERATURE CITED

- ANDRUS, R. E. and E. F. LAYSER. 1976. *Sphagnum* in the northern Rocky Mountains of the United States. *The Bryologist* 79(4):508–511.
BURSIK, R. J. 1990. Floristic and phytogeographic analysis of northwestern Rocky Mountain peatlands, U.S.A. M.S. thesis. University of Idaho, Moscow, ID.

- COOPER, S. V., K. E. NEIMAN, R. STEELE, and D. W. ROBERTS. 1987. Forest habitat types of northern Idaho: a second approximation. General Technical Report INT-236. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.
- DAMMAN, A. W. H. and J. J. DOWHAN. 1981. Vegetation and habitat conditions in Western Head Bog, a southern Nova Scotian plateau bog. *Canadian Journal of Botany* 59:1343-1359.
- and T. W. FRENCH. 1987. The ecology of peat bogs of the glaciated Northeastern United States: a community profile. U.S. Fish & Wildlife Service Biological Report 85(7.16).
- DUNLOP, D. A. 1987. Community classification of the vascular vegetation of a New Hampshire peatland. *Rhodora* 89:415-440.
- FLORA OF NORTH AMERICA EDITORIAL COMMITTEE. 1993. Flora of North America, Vol. 2: Pteridophytes and Gymnosperms. Oxford University Press, New York.
- GLASER, P. H. 1983. Vegetation patterns in the North Black River peatland, northern Minnesota. *Canadian Journal of Botany* 61:2085-2104.
- and D. FOSTER. 1984. The vascular flora of raised bogs in southeastern Labrador and its phytogeographic significance. *Canadian Journal of Botany* 62: 1361-1364.
- HITCHCOCK, C. L. and A. CRONQUIST. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA.
- HORTON, D. G., N. MALMER, and D. H. VITT. 1993. Peatland classification: how important are bryophytes? *American Journal of Botany* 80(6)Suppl.:1-2.
- JANSSENS, C. R. 1967. A floristic study of forests and bog vegetation, northwestern Minnesota. *Ecology* 48:751-765.
- JEGLUM, J. K. 1971. Plant indicators of pH and water levels in peatlands at Candle Lake, Saskatchewan. *Canadian Journal of Botany* 49:1661-1676.
- . 1975. Vegetation-habitat changes caused by damming a peatland drainageway in northern Ontario. *Canadian Field Naturalist* 89(4):400-412.
- KARLIN, E. F. and L. M. LYNN. 1988. Dwarf-shrub bogs of the southern Catskill Mountain region of New York State: geographic changes in the flora of peatlands in northern New Jersey and souther New York State. *Bulletin of the Torrey Botanical Club* 115:209-217.
- KENEL, N. C. 1987. Trends and interrelationships in boreal wetland vegetation. *Canadian Journal of Botany* 65:12-22.
- LAWTON, E. 1971. Moss flora of the Pacific Northwest. The Hattori Botanical Laboratory, Nichinan, Miyazaki, Japan.
- LESICA, P. 1986. Vegetation and flora of Pine Butte Fen, Teton County, Montana. *Great Basin Naturalist* 46:22-32.
- MITCHELL, C. C. and W. A. Niering. 1993. Vegetation changes in a topogenic bog following beaver flooding. *Bulletin of the Torrey Botanical Club* 120:136-147.
- MOSELEY, R. K. and C. R. GROVES. 1992. Rare, threatened and endangered plants and animals of Idaho, 2nd ed. Idaho Department of Fish and Game, Conservation Data Center, Boise, ID.
- Moss, E. H. 1953. Marsh and bog vegetation in northwestern Alberta. *Canadian Journal of Botany* 31:448-470.
- . 1959. Flora of Alberta. Univ. Toronto Press, Toronto, Ontario.
- MOTZKIN, G. H. and W. A. PATTERSON III. 1991. Vegetation patterns and basin morphometry of a New England moat bog. *Rhodora* 93:307-321.
- OVDENEN, L. and G. BRASSARD. 1989. Wetland vegetation near Old Crow, northern Yukon. *Canadian Journal of Botany* 67:954-960.
- POLLETT, F. C. and P. B. BRIDGEWATER. 1973. Phytosociology of peatlands in central Newfoundland. *Canadian Journal of Forest Research* 3:433-442.
- RABE, F. W., R. BIGGAM, R. BRECKENRIDGE, and R. NASKALI. 1986. A limnological description of selected peatland lakes in Idaho. *Journal of the Idaho Academy of Sciences* 22:63-90.

- RUMLEY, J. H. 1956. Plant ecology of a bog in northern Idaho. Ph.D. dissertation. Department of Botany, Washington State University, Pullman.
- SCHWINTZER, C. R. 1978a. Nutrient and water levels in a small Michigan bog with high tree mortality. *American Midland Naturalist* 92:447-459.
- . 1978b. Vegetation and nutrient status of northern Michigan fens. *Canadian Journal of Botany* 56:3044-3051.
- and G. WILLIAMS. 1974. Vegetation changes in a small Michigan bog from 1917 to 1972. *American Midland Naturalist* 92:447-459.
- SLACK, N. G., D. H. VITT, and D. HORTON. 1980. Vegetation gradients of mineralotrophically rich fens in western Alberta. *Canadian Journal of Botany* 58:330-350.
- STEWART JR., C. N. and E. T. NILSEN. 1993. Association of edaphic factors and vegetation in several isolated Appalachian peat bogs. *Bulletin of the Torrey Botanical Club* 120:128-135.
- VITT, D. H. and S. BAYLEY. 1984. The vegetation and water chemistry of four oligotrophic basin mires in northwestern Ontario. *Canadian Journal of Botany* 62:1485-1500.
- and N. G. SLACK. 1975. An analysis of the vegetation of *Sphagnum*-dominated kettle-hole bogs in relation to environmental gradients. *Canadian Journal of Botany* 53:332-359.
- and —. 1984. Niche diversification of *Sphagnum* relative to environmental factors in northern Minnesota peatlands. *Canadian Journal of Botany* 62:1409-1430.
- , P. ACHUFF, and R. E. ANDRUS. 1975. The vegetation and chemical properties of patterned fens in the Swan Hills, north central Alberta. *Canadian Journal of Botany* 53:2776-2795.
- WELLS, E. D. 1981. Peatlands of eastern Newfoundland: distribution, morphology, vegetation, and nutrient status. *Canadian Journal of Botany* 59:1978-1997.
- WHEELER, G. A., P. GLASER, E. GORHAM, C. WETMORE, F. BOWERS, and J. JANSENS. 1983. Contributions to the flora of the Red Lake Peatland, northern Minnesota, with special attention to *Carex*. *American Midland Naturalist* 110:62-92.

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